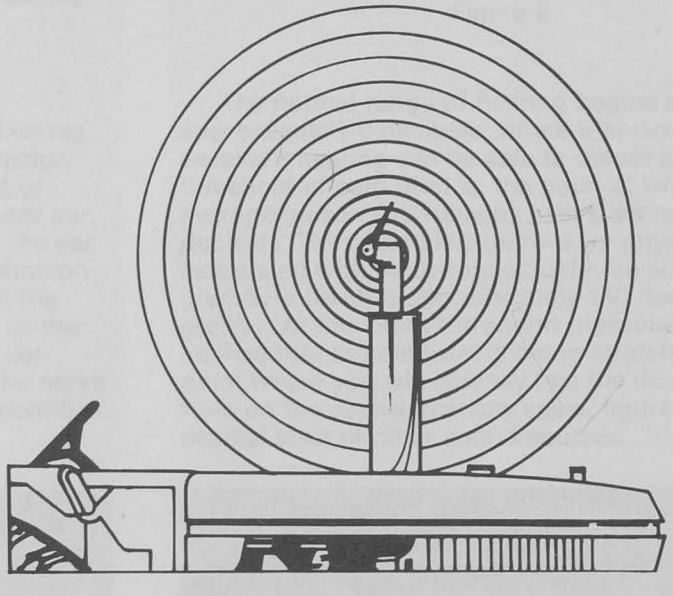
Extension Folder 549—1980

NOISE The INVISIBLE Agricultural Hazard



Agricultural Extension Service
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NOISE The INVISIBLE Agricultural Hazard

What would your life be like without the many sounds you often take for granted, such as the voices of family and friends, market and weather reports broadcast over the radio, music, and the sound of farm equipment running smoothly? Many farmers could answer this question for you since, according to recent studies on occupational groups, farm workers experience one of the highest incidences of noise-induced hearing loss.

When working around the farm, there are many potential sources of high sound levels that can be destructive to your hearing—tractors, aeration fans on grain bin dryers, combines, chain saws, and snowmobiles, for example. In addition to being potentially physically destructive to your hearing, working around noisy equipment can interfere with communication between individuals.

For the purposes of our discussion here, **sound becomes noise when it becomes distracting to you or when it reaches a level that is potentially destructive to your hearing. We will use the terms "noise" and "high sound levels" interchangeably.**

HOW WE HEAR

Sound is transferred to the ear by sound waves emitted from a vibrating source such as a tractor.

As illustrated in figure 1, our ears consist of three major parts—the outer, middle, and inner ear. The outer ear funnels sound waves through the ear canal, where they strike the eardrum. The vibration of the eardrum is transmitted to the nerve of the inner ear by three small bones which make up the middle ear. The sensitive nerve of the inner ear converts the vibrations to nerve impulses. The nerve impulses are sent to the brain, which then identifies the sound.

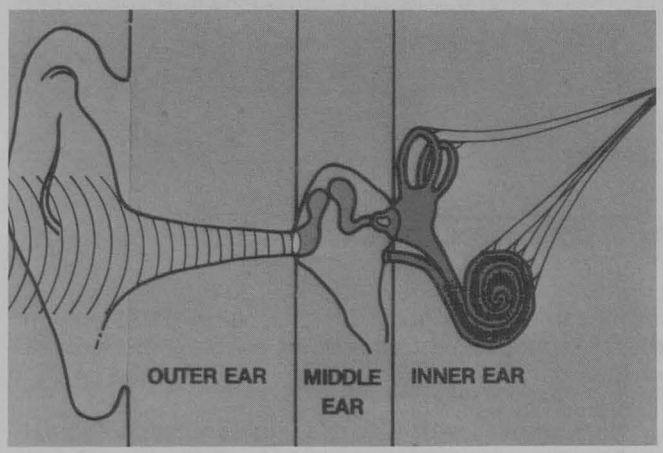


Figure 1

PROPERTIES OF SOUND OR NOISE

Even though we cannot see sound, it is a force with very real dimensions and three definite properties—intensity, frequency, and duration.

INTENSITY

The loudness of a sound, or the amount of pressure it exerts through the ear, is the intensity. Sound intensity is measured in units called decibels, often abbreviated dB (see figure 2).

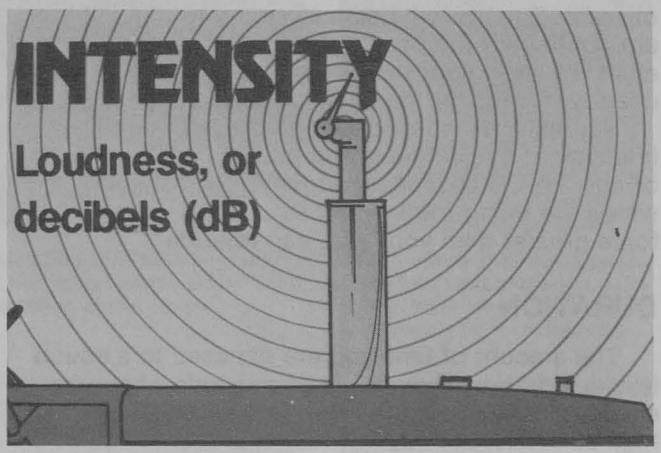


Figure 2

The normal range of hearing begins at approximately 0 decibels, where a person with excellent hearing will be able to detect a sound. The threshold of pain (that is, the point at which the average person experiences pain from noise) is 140 decibels. Thus, normally there is no physical pain associated with most sounds until the sound presssure reaches approximately 140 decibels or greater. At this point the sound pressure is so intense that the eardrum is being stretched to the point where you will actually feel the discomfort. Note on the sound intensity scale, figure 3, the decibel level of other sound sources.

SOUND INTENSITY SCALE

DECIBEL LEVEL	SOUND SOURCE
140	THRESHOLD OF PAIN: Gun shot, siren at 100 feet
135	THRESHOLD OF FEELING: Jet takeoff, amplified music
120	Noisy tractor, chain saw, snowmobile
105	Tractors, combines
90	DANGER LEVEL
85	Inside acoustically insulated tractor cab
75	Average radio, vacuum cleaner
60	Normal conversation
45	Rustling leaves, soft music
30	Whisper
15	Threshold of hearing
0	Weakest sound

Figure 3

FREQUENCY

The number of sound waves produced per second by a sound source is frequency. Sound frequencies are measured in cycles per second (cps), also called hertz (Hz). A high-pitched sound is a high frequency sound; likewise, a low-pitched sound would be a low frequency sound. The human voice has a range of about 200 to 4,000 cps or Hz.

In normal conversation, the 4,000 cps sounds give clarity to speech. When we begin to lose our hearing as a result of a noise-induced hearing loss, we first begin to lose our ability to hear sounds at the 4,000 cps level. Thus, the first sign of a hearing loss is the inability to understand people or other sources of voice communication such as television or radio. Sounds will begin to sound muffled. If you are continually exposed to high noise sources, your ability to hear other frequency levels will begin to be destroyed until you go deaf.

Sounds that are most dangerous are high in intensity or decibel level and have a high frequency or cps. This is because a large number of sound waves are being transmitted through the ears with a force greater than your ears can tolerate.

DURATION

The amount of time you are exposed to a sound level is duration. Figure 4 is an example of a noise exposure scale. The right-hand column lists various high sound levels. The left-hand column indicates the length of exposure that is safe for the corresponding noise level during a day. These figures have been determined after years of research on noise-induced hearing loss and are presently accepted as the standard for allowable noise level exposures.

Permissible Noise Exposure Scale

DURATION (Hours per day)	SOUND LEVEL (Decibels)
8	90
4	95
2	100
1	105
½	110
¼ or less	115

Figure 4

Note that the average person can be exposed to a sound source producing 90 dB for a maximum of 8 hours. If the sound level is at 100 dB, then the maximum exposure to the sound is 2 hours. An unprotected ear can be exposed to 115 dB for a maximum of only 15 minutes a day. Your ears should not be directly exposed for any length of time to sounds greater than 115 dB.

It is also important to point out that sound pressure increases logarithmically. In other words, sound pressure doubles approximately every 5 dB. Thus, a sound level at 95 dB is twice as loud as a sound at 90 dB. Also you can be exposed to a sound at 95 dB only half as long as you can to a sound at 90 dB without hearing protection.

HOW HIGH SOUND LEVELS DAMAGE HEARING

A sound that possesses a high frequency and decibel level passing through the ear can over-stimulate the nerve in the inner ear to the point of causing permanent damage to the nerve. (see figure 5). Your ears can recover from a short duration of a high sound level. But if the exposure is excessive during a given day, your ears can weaken and the inner ear can begin to be destroyed.

As previously mentioned, during the first stages of hearing loss, our ability to hear high frequency sounds is destroyed first. Because high frequency sounds give clarity to speech, the first normal sign of hearing loss is the inability to understand people talking to you. As the damage progresses, it becomes harder to hear, until almost all hearing is lost.

There are some causes of hearing loss that may not be permanent, such as infection in the middle ear, rupture of the eardrum, and disease of the middle ear. All these causes of hearing loss can be repaired or cured with surgery or medical treatment. **But noise-induced hearing loss is a permanent destruction of the inner ear nerve and cannot be repaired.**

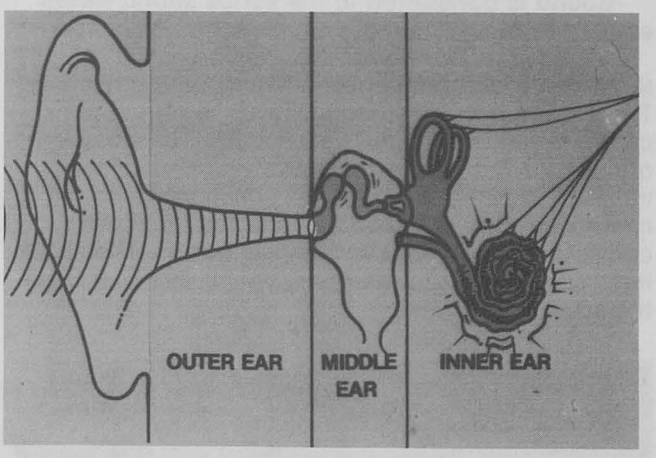


Figure 5

OTHER PROBLEMS

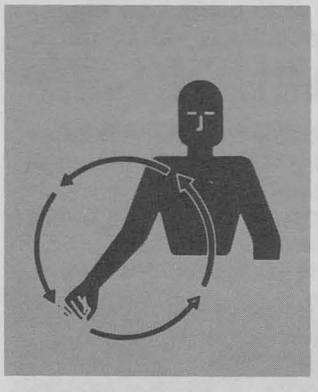
In addition to damaging hearing, high sound levels can cause other problems. Noise makes blood vessels constrict, shutting down the flow of blood to various parts of the body and causing fatigue and headaches.

High sound levels also may lead to psychological problems such as nervousness, depression, and irritability.

AGRICULTURAL HAND SIGNALS

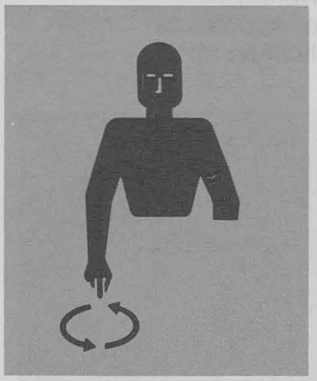
Noise produced by farm equipment often interferes with normal speech and communication, whether or not you are wearing personal protective equipment. On a farm, the need to communicate information quickly and correctly may prevent a serious injury or death. In recent years, the American Society of Agricultural Engineers has developed a set of agricultural hand signals to be used around high sound level farm equipment. These hand signals allow workers to communicate with each other more efficiently. They save time, and they also could prevent a serious injury or death from occurring (see figure 6).

Figure 6



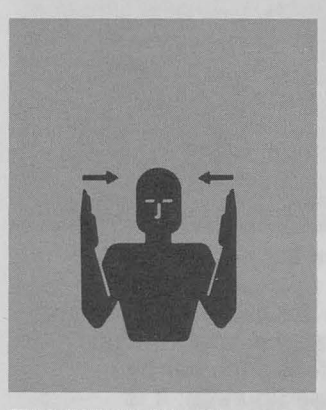
START THE ENGINE—Simulate cranking of vehicles by moving arm in a circular motion at waist level.

RAISE EQUIPMENT—Make circular motion with either hand at head level.

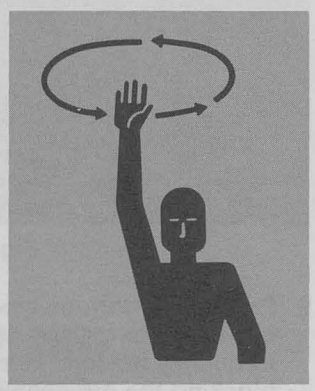


LOWER EQUIPMENT—Make circular motion with either hand pointing to the ground.

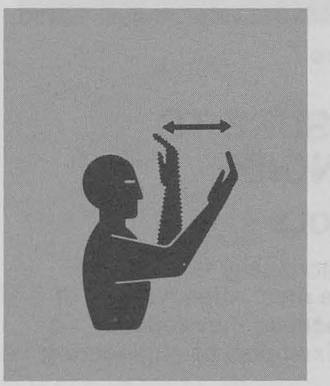
STOP—Raise the hand upward to the full extent of the arm, palm to the front. Hold that position until the signal is understood.



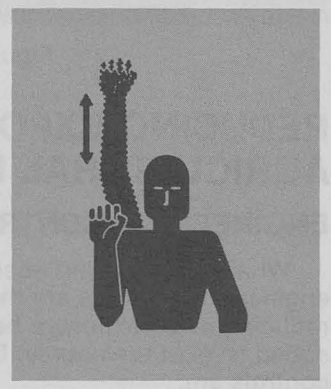
THIS FAR TO GO—Place palms at ear level facing head and move laterally inward to indicate remaining distance to go.



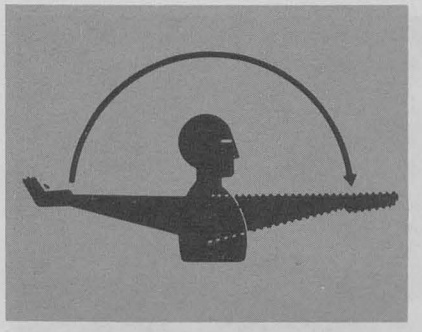
COME TO ME—Raise the arm vertically overhead, palm to the front, and rotate in large horizontal circles.



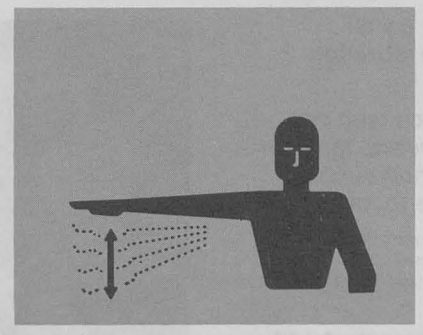
MOVE TOWARD ME—FOLLOW ME—Point toward person(s), vehicle(s), or unit(s); beckon by holding the arm horizontally to the front, palm up, and motioning toward the body.



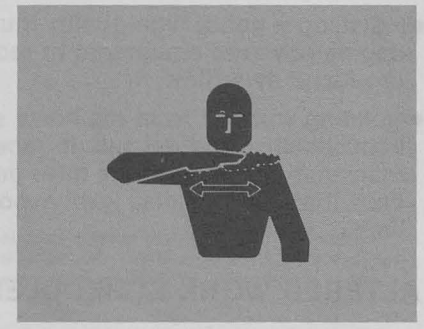
SPEED IT UP-INCREASE SPEED—Raise the hand to the shoulder, fist closed; thrust the fist upward to the full extent of the arm and back to the shoulder rapidly several times.



MOVE OUT—TAKE OFF—Face the desired direction of movement; hold the arm extended to the rear; then swing it overhead and forward in the direction of desired movement until it is horizontal, palm down.



SLOW IT DOWN—DECREASE SPEED—Extend the arm horizontally sideward, palm down, and wave arm downward 45° minimum several times, keeping the arm straight. Do not move arm above horizontal.



STOP THE ENGINE—Draw right hand, palm down, across the neck in a "throat cutting" motion from left to right.

SOURCES OF AGRICULTURAL NOISE

To date, highly mechanized farms have many potential high sound sources. See figure 7 for examples.

You can obtain information on the sound levels of various models of tractors by writing to: Nebraska Tractor Test Data; Department of Agricultural Engineering; University of Nebraska—Lincoln; College of Agriculture; Lincoln, Nebraska 68583. Ask for publication MP37.

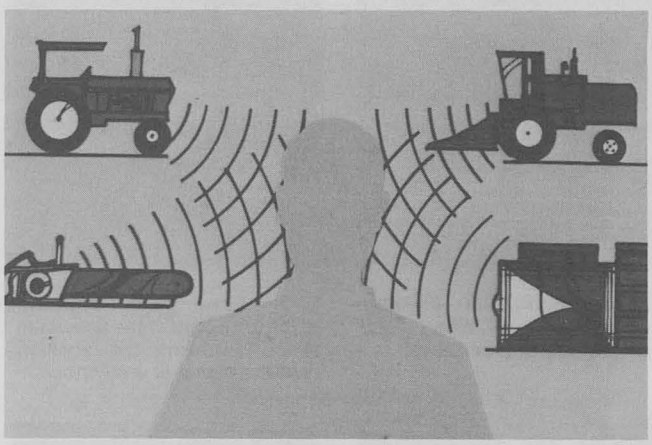


Figure 7

REDUCING EXPOSURE TO AGRICULTURAL NOISE

ENGINEERING CONTROLS

When practical and economically feasible, engineering controls are the most effective way of reducing noise exposure because they reduce sound level at the source. Examples of engineering controls are:

- replacing worn, loose, or unbalanced machine parts to cut down on amount of vibration generated.
- making sure that machine parts are well-lubricated to cut down on noise exposure created by friction.
- installing a good, high-quality muffler on all engine-powered equipment to reduce vibration produced by airflow.
- isolating yourself from the noise source with an acoustically-designed cab. In recent years, farm machinery manufacturers have designed such cabs that reduce noise level exposure to safe limits.

ALTERED WORK SCHEDULES

A second alternative to preventing noise-related problems is to reduce the amount of exposure to high sound levels on farms. This can be done by arranging work schedules, when practical, so that farm workers do not exceed the allowable exposure limit to a high noise source.

For example, if you have a tractor that produces a noise level of 95 dB, the safe exposure to this noise level is 4 hours per day per person. Work schedules could be arranged to let farm workers exchange work activities so that no one person is exposed to the noise from that tractor for more than 4 hours a day.

EAR PROTECTION

The final alternative is to wear some type of hearing protection that will effectively reduce noise exposure.

There are two basic types of hearing protection:

1. Ear muffs—these are probably the most effective in reducing noise exposure. They cover the entire ear and can easily be put on and taken off, although they may cause some discomfort in hot weather (see figure 8).

Figure 8

2. Ear plugs—various types are available. They are inserted into the ear canal and prevent high frequency noise from entering the ear by blocking the ear canal (see figure 9). It is important that the wearer knows how to properly insert the ear plug. When purchasing ear plugs, make sure the directions for insertion are closely followed so that a snug, tight fit is obtained in the ear canal when the plug is inserted.

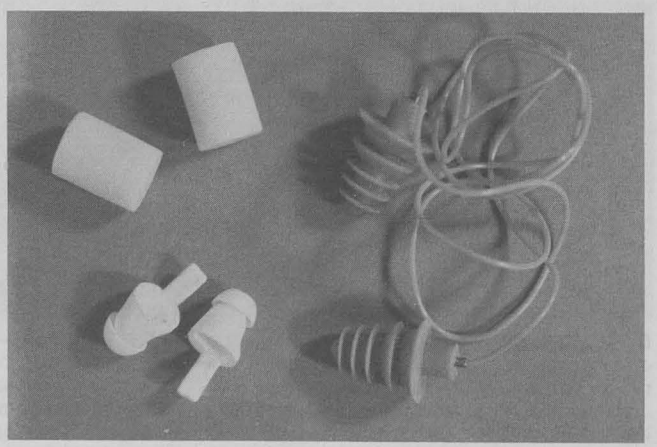


Figure 9

Warning: Cotton should never be used for the purpose of reducing noise exposure. Cotton cannot block out high frequency sound and will provide no protection from high sound levels.

Ear protective devices will not block out all sounds. They will block out only those sounds that are dangerous to hearing. You still will be able to hear your farm machinery running and communicate with others as long as there are no other interfering sounds.

HAVE YOUR HEARING TESTED

If you are continually exposed to high sound level sources in your environment, you should have a hearing test periodically. This test, called an audiogram, will reveal signs of hearing loss as a result of high sound level exposure. If a hearing loss is noted, the necessary steps should be taken to reduce exposure—thus, eliminating further damage to your hearing.

IT'S UP TO YOU

The ability to hear is a valuable gift that provides joy and happiness in our lives, and helps us work efficiently with those around us. If you allow your ears to be exposed to the invisible dangers of agricultural noise or other high sound level sources, the result could be a permanent loss of hearing. You can make the difference between a life with all the joys of sound or a life of silence by following the safe work procedures outlined in this folder. What will be your choice?

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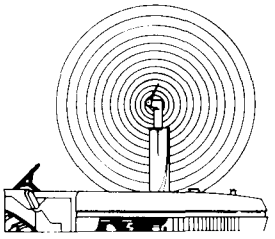

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